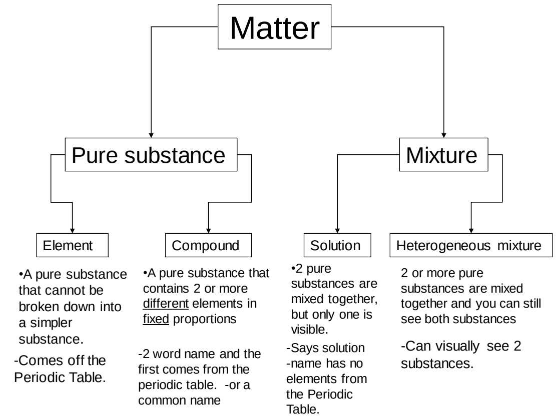
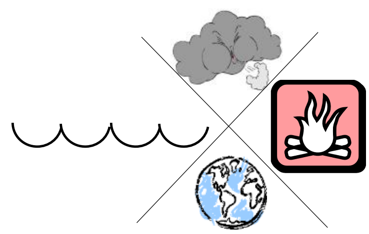
Science 10

Chemistry



Atomic theory

- A theory is a set of ideas that people produce to help explain an event.
- Theories are always changing as new information is found.
- Before 400 B.C. it was thought that substance were made up of combinations of 4 elements.
  - Earth, wind, water, fire

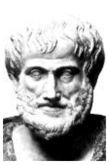


The four elements, water, wind, fire and earth could be combined in varying amounts to produce every other substance

The right proportion of fire and earth would form copper.

Democritus

- 400 B.C. - Democritus thought matter could not be divided indefinitely.
- This led to the idea of <u>atoms</u> in a void.



Aristotle

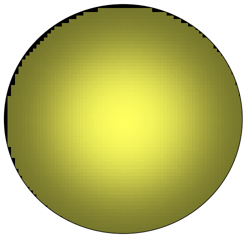
- 350 B.C - Aristotle modified an earlier theory that matter was made of four "elements": earth, fire, water, air.
- Aristotle was wrong. However, his theory persisted for 2000 years.

John Dalton

- All matter is made of atoms.
- Atoms of an element are identical.
- Each element has different atoms.
- Atoms of different elements combine in constant ratios to form compounds.
- Atoms are rearranged in reactions.

Dalton's Model of the Atom

All substances that are the same are made of the same atoms.

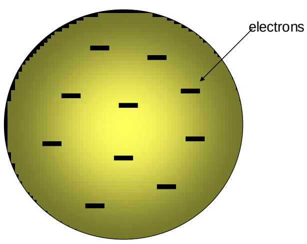


J.J. Thomson

- Discovered the electron.
  - Atoms have electrons.
  - Electron have small mass and a negative charge.
  - The rest of the atom is positive.
  - The electrons are stuck in the atom to make it neutral.

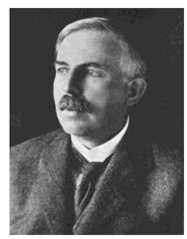
Thomson's Model of the atom

The "Plum Pudding" Model of the atom.

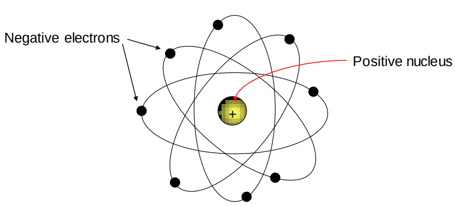


Ernest Rutherford

- Discovered the nucleus of the atom.
  - The atom has a very dense, positive core.
  - Surrounded by empty space with fast moving electrons.

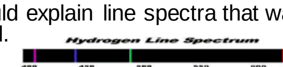


Rutherford's Model of the Atom



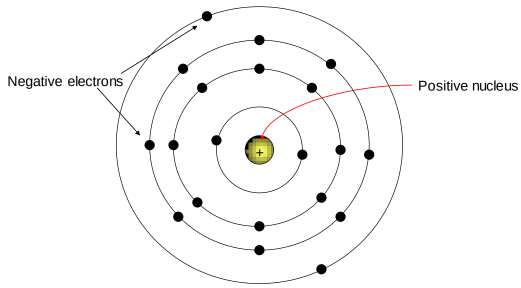
Niels Bohr

- Proposed the planetary model of the atom.
- This would explain line spectra that was observed.



  - Electrons orbit around the nucleus like planets around the Sun.
  - Electrons have a definite orbit.
  - Electrons cannot be between orbits.
  - The further away the orbit is from the nucleus, the greater the energy needed to be there.
  - The order that electrons filled the first three orbits is 2, 8, 8.

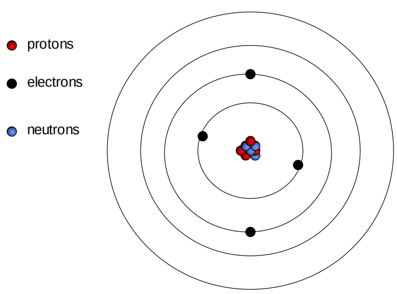
Bohr's Model of the Atom



Modern Atomic Theory

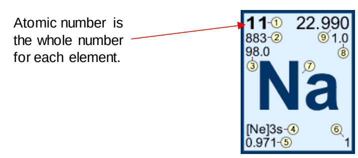
- Atoms are composed of 3 subatomic particles.
  - Protons- Positively charged (+)
    - Relative mass of 1
    - Located in the Nucleus.
  - Neutrons- Neutral (no) charge
    - relative mass of 1
    - Located in the nucleus
  - Electrons- Negatively charged (-)
    - relative mass of 0 (actually 1/2000$^{th)}$
    - Travels in orbits around the nucleus.

Modern Atomic Model

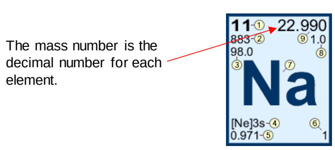


How Many Subatomic Particles are in Each Atom

- Each atom is neutral (no charge)
  - Have to have the same # of protons and electrons
- The number of protons is stated in the atomic number of the element.



- The number of neutrons can be found using the mass number or atomic weight.
- The mass number is the number of protons **and** neutrons found in the atom.
  - It is the overall mass of the atom.



- The mass number is an average mass of all the isotopes of an elements.
- Typically we round the mass number from the periodic table unless there is a mass number or # of neutrons provided for you.

Sodium has an atomic number of 11. It has 11 protons and 11 electrons.

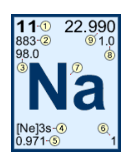
Sodium has a mass number rounded to 23. Since we now it has 11 protons, it must have 12 neutrons to equal 23.

p + n = mass #

11 + n = 23

n = 23 - 11

n = 12



Isotopes

- An <u>isotope</u> is when there is more than 1 type of the same element.
- The element have the <u>same atomic number</u>, but a <u>different mass number</u>.
  - A different number of neutrons.

Ex. chlorine has 2 isotopes, one with mass number 35 and one with mass number 37.

Therefore one chlorine has 18 neutrons and the other has 20 neutrons.

- The isotope is usually given by the mass number.

Ex. Cl-35 or Cl-37

- Isotopes have the same physical and chemical properties and changes.

Ions

- Since <u>electrons</u> are moving around the <u>outside</u> of an atom, sometimes electrons can be <u>gained or lost</u>.
- An atom that has gained or lost electrons is called an <u>ion</u>.
- An ion is indicated by comparing the number of protons and electrons

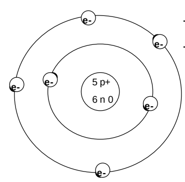
Charge = protons - electrons

This is an atom of Boron. It has:

-5 e-

-5 p+

-6 n 0



If the atom gained one electron, it will have:

-6 e-

-5 p+

-6 n 0

This leaves the atom as a -1 ion.

Charge = protons – electrons

Charge = 5 - 6

Charge= -1

If the atom loses an electron, it is left with:

-4 e-

-5 p+

-6 n 0

This leaves the atom as a +1 ion.

Charge = protons – electrons

Charge = 5 - 4

Charge= +1

If the atom loses two electrons, it is left with:

-3 e-

-5 p+

-6 n 0

This leaves the atom as a +2 ion.

Charge = protons – electrons

Charge = 5 - 3

Charge= +2

Representation

- Shorthand way to include all the subatomic information about an atom.

1. Element Symbol is written in the centre.

3. Mass Number is written to the top left,

4. Ionic charge is written to the top right.

X

2. Atomic number is written to the bottom left.

Write the representation for Oxygen with 10 electrons.

$$^{16}_{8}O^{-2}$$

Element	Atomic #	Mass #	Repres-entation	# of protons	# of neutrons	# of electrons
Al	13	27	$^{27}_{13}Al^{+3}$	13	14	10
Ca	20	40	$^{40}_{20}Ca$	20	20	20
S	16	32	$^{32}_{16}S^{-2}$	16	16	18
Au	79	197	$^{197}_{79}Au^{+1}$	79	118	78
I	53	129	$^{129}_{53}I$	53	76	53

Bohr Diagrams

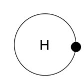
- A Bohr diagram is a representation of the atom showing where the electrons are.
- Only the electrons are shown because they are the subatomic particles involved in bonding.

Rules

1. Electrons are added starting from the lowest available energy level.
2. A level must be full before you can move on to the next level.
3. The max. number of electrons in the first 3 orbits is 2, 8, 8.

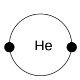
Bohr Diagram of Hydrogen

Hydrogen has an atomic number of 1, therefore 1 electron. The electron gets added to the first orbit.



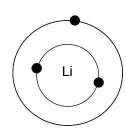
Bohr diagram of Helium

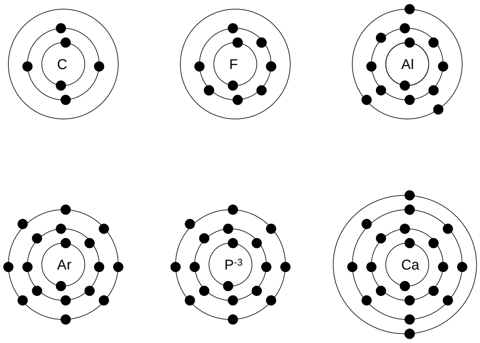
Helium has an atomic number of 2, therefore 2 electrons. The 2 electrons both get added to the first orbit.



Bohr diagram of Lithium

Lithium has an atomic number of 3, therefore 3 electrons. 2 electrons get added to the first orbit, 1 electron to the second orbit.

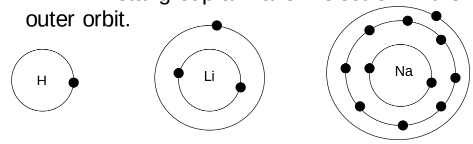




Electron Arrangements

- Groups in the periodic table tend to have similar electron arrangements
  - They have the same number of electrons in their outer orbit.

Ex. Alkili metal group all have 1 electron in the outer orbit.

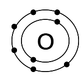


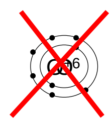
Forming Stable Ions

- Typically an atom is more stable when it has a full outside orbit.
- Atoms will gain or lose electrons in the shortest way to get a full outer orbit.

To get a full outer orbit, oxygen can either:

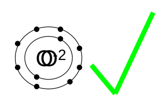
1. Lose 6 electrons
2. Gain 2 electrons



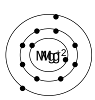


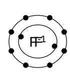
Which is the shortest way to get a full orbit?

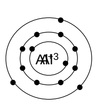
Lose 2 electrons?

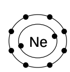


Determine the stable ions





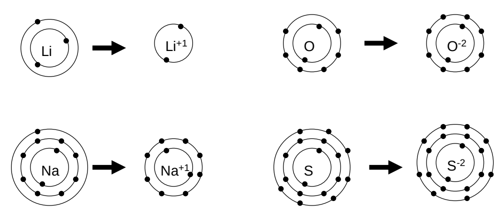




Already stable, no ion formed.

Ion Formation Trends on the Periodic Table

- Since groups have the same number of electrons in their outer orbit, they will form the same type of ion.



Periodic Table Trends

- Alkili metals: +1 charge
- Alkili Earth metals: +2 charge
- Boron's group: +3
- Nitrogen's group: -3
- Oxygen's group: -2
- Halogen's: -1
- Noble gases: no charge

*Carbon's group doesn't usually form ions, but they can form either -4 or +4 ions.

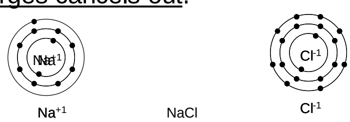
Bonding

- When atoms combine, they form a bond (connection).
- There are 2 types of bonds that can be formed.

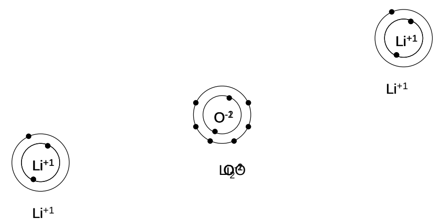
1. Ionic bonds
2. Covalent bonds

Ionic bonds

- The bond is an electrical attraction between positive ions (cations) and negative ions (anions).
  - Always a metal bonded to a non-metal.
- The ions bond in such a way that the charges cancels out.



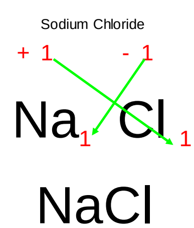
Reacting Lithium and Oxygen



Writing Chemical Formulas for Ionic Compounds

- There are 4 steps when writing a chemical formula for an ionic compound

1. Write the element symbols (metal 1st).
2. Write the charge above the appropriate symbol.
3. Criss-Cross the values.
4. Simplify the values and write the formula.



Magnesium Bromide

+2 -1

$Mg_1 \; Br_2$

$MgBr_2$

Aluminum Nitride

+3 -3

$Al_{3} \; N_{3}$ (3s crossed out)

AlN

The same applies for polyatomic ions

Aluminum Nitrate

+3 -1

$Al_1 \; NO_{3\,3}$

$Al(NO_3)_3$

The brackets tell us that we have 3 nitrates

- You can tell the whether or not the second element comes from the periodic table or the polyatomic ion chart by the ending.
- If it ends in –ide, it comes from the periodic table
  - Exception- hydroxide (OH^-)
- If it ends in –ate or –ite, it comes from the polyatomic ion chart

Ammonium Sulfate

+1 -2

$NH_{4\,2} \; SO_{4\,1}$

$(NH_4)_2SO_4$

Transition Metals in Ionic Compounds

- Many transition metals can have more than 1 charge unlike the rest of the elements from the periodic table.
- The charge being used in the ionic compound is shown with a Roman numeral.

Ex. Copper (I) is Cu^{+1}

Copper (II) is Cu^{+2}

Copper (II) Sulfate

+2 -2

Cu SO$_4$

2 2

$CuSO_4$

Tin (IV) Oxide

+4 -2

Sn O

2 4

1 2

SnO_2

- There are four major transition metals that we will use that have more than 1 charge.

- Copper (I) and Copper (II)
- Iron (II) and Iron (III)
- Tin (II) and Tin (IV)
- Lead (II) and Lead (IV)

Naming Ionic Compounds

- There a 3 steps in naming ionic compounds.

1. Name the metal (or ammonium)(add roman numerals for transition metals).
2. Name the non-metal or polyatomic ion.
3. Change the ending of the non-metal to -ide.

NaCl

Sodium Chloride

K_2S

Potassium Sulfide

Mg_2N_3

Magnesium Nitr ide ogen

$MgSO_4$

Magnesium Sulfate

$Al(NO_3)_3$

Aluminum Nitrate

- For Transition metals, you need to figure out the charge of the ion so you can include the Roman Numeral.
- This is done by the reverse criss-cross.

1. Reverse criss-cross the subscripts
2. Check the non-metal or polyatomic ion.
3. Multiply the charges to make the non-metal or polyatomic ion correct.

+3 -1

$FeCl_3$

1

Check the charge on chlorine.

The charge matches up.

Iron is a +3 charge. The ion is Iron (III).

Iron (III) chloride

+2 -1

$FeCl_2$

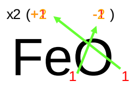
1

Check the charge on chlorine.

The charge matches up.

Iron is a +2 charge. The ion in Iron (II).

Iron (II) chloride



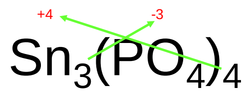
Check the charge on oxygen.

The charge does not match up.

Multiply the charge by 2 to get the correct charge for oxygen

Iron is a +2 charge. The ion in Iron (II).

Iron (II) oxide



Check the charge on phosphate.

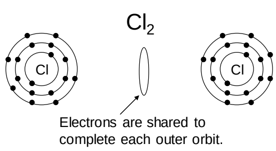
The charge matches up.

Tin is a +4 charge. The ion in Tin (IV).

Tin (IV) phosphate

Covalent Bonds

- The bond is the sharing of electrons between two atoms.
  - Always a non-metal bonded to a non-metal.
- The atoms bond in such a way that the outer orbit of each atom is completed.



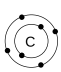
Simple Formulas for Covalent Compounds

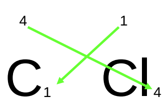
- There are 4 steps when writing a chemical formula for simple covalent compounds.

1. Write the element symbols (most left 1st).
2. Write the number of empty spaces left in the orbit above the appropriate symbol.
3. Criss-Cross the values.
4. Simplify the values and write the formula.

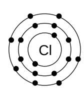
Combining Carbon and Chlorine

Carbon has 4 spaces left in its outer orbit



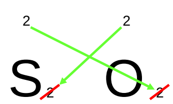


Chlorine has 1 space left in the outer orbit.



CCl_4

Combining Sulfur and Oxygen



SO

Writing Names of Covalent Molecules

- Covalent molecules can combine in many different ways.
- For this, we have to indicate the number of each type of element present.

1-mono	6-hexa
2-di	7-hepta
3-tri	8-octa
4-tetra	9-nona
5-penta	10-deca

- There are 3 rules for writing names of covalent molecules.

1. Write the first element with a prefix (do not use mono for one atom)
2. Write the second element with a prefix.
3. Change the ending of the second element to –ide.

CCl_4

Carbon tetrachloride

Mono is not added because it is the 1st element.

N_2O_5

Dinitrogen pentaoxide

PCl_3

Phosphorous trichloride

Writing Formulas for Covalent Molecules

- There are 2 rules for writing formulas for covalent compounds.

1. Write the symbol and subscript given by the prefix for the 1st element.
2. Write the symbol and subscript given by the prefix for the 2nd element.

Do not simplify

Silicon dioxide

SiO_2

Tricarbon hexaselenide

C_3Se_6

Recognizing the Type of Bonding

- The first element will tell you the type of bonding
  - Therefore it tells you the type of Formula, and Naming.
- If the first element is:
  - A metal- use ionic naming and formulas.
    - Exception NH_4^+ is considered a metal
  - A non-metal- use covalent naming and formulas.
  - Hydrogen- use acid naming and formulas.
    - Exception CH_3COOH has the Hydrogen at the end.

Names	Bonding	Formula
Sodium chloride	Ionic	NaCl
Carbon dioxide	Covalent	CO_2
Magnesium Oxide	Ionic	MgO
Tin (II) sulfate	Ionic	$SnSO_4$
Hydrofluoric acid	Acid	HF
Phosphorous pentachloride	Covalent	PCl_5
Phosphoric acid	Acid	H_3PO_4

Formula	Bonding	Names
$CaBr_2$	Ionic	Calcium bromide
CuO	Ionic	Copper(II) oxide
HNO_3	Acid	Nitric acid
N_2O_5	Covalent	Dinitrogen pentoxide
$(NH_4)_2CO_3$	Ionic	Ammonium carbonate
HBr	Acid	Hydrobromic acid
$SiCl_4$	Covalent	Silicon tetrachloride

Common Names

- Some compounds and molecules are not recognized by their systematic name but as their common name.

Ex. H_2O – water

H_2O_2 – Hydrogen peroxide

NH_3 – Ammonia

etc.

Hydrocarbons

- A molecule that contains Carbon and Hydrogen is known as a hydrocarbon.
  - It is also known as an organic molecule.
- Because of the number of bonds on a carbon, there are thousands of combinations with hydrogen and carbon alone.
- There is a special naming system for hydrocarbons.

Diatomic Elements

- There is a group of elements from the periodic table that do not remain as a single atom in element form.
  - Most elements are in single atom form as an element.

  Ex. Copper is just 1 Cu atom

  Aluminum is just 1 Al atom

- The diatomic elements are
  H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2, At_2
- There are a couple ways to remember these elements
  At-(H-O-F-Br-I-N-Cl)

Or

Super 7 plus the bonus

Start at atomic number 7, make the shape of a 7 with 7 elements. The bonus is Hydrogen.

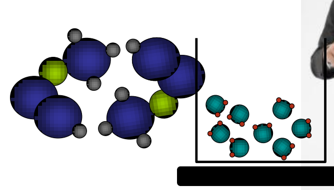
Changes

- Matter can be changed in two ways

1. Physical Change
2. Chemical Change

Physical Change

- Change in a substances state or shape.
  - The same combination of matter is still present. (same properties)



Chemical Change

- When a brand new substance is formed.
  - The substance will have brand new properties.

Clues to Identify a Chemical Change

- There are five clues that can help identify a chemical change

1. 'Unexpected' colour change.
2. Heat or light is released.
3. Gas, or bubbles are produced.
4. Solid (precipitate) produced from mixing two liquids.
5. Difficult to reverse

Chemical Tests

- Sometimes chemical changes can be used to identify a substance.
  - Oxygen will cause a glowing splint to burst into flames.
  - Hydrogen will cause a burning splint to 'pop' or 'explode'.
  - Carbon dioxide will cause a burning splint to go out and turn limewater cloudy.
  - Water vapour will turn cobalt chloride paper pink.

Representing Chemical Changes

- There are several ways to represent what occurs during a chemical change.
- The change can be expressed through:
  - Word equations.
  - Skeleton equation.
  - Balanced chemical equations.
- Every chemical change contains substance that are:
  - Reactants (starting materials that will react)
  - Products (ending materials that were made during the reaction)

Word Equations

- The chemical change is expressed using the chemical names of the reactants and products.
- The chemical are separated by a '+' sign.
- The reaction is indicated by a '→' sign.

Ex.

Methane + Oxygen → Water + Carbon Dioxide

Ex. When Cu wire is put in a solution of $AgNO_3$, we form a coat of Ag in a $Cu(NO_3)_2$ solution.

- Copper + silver nitrate → Silver + copper (II) nitrate

Skeleton Equations

- The chemical change is expressed using the chemical formulas of the reactants and products.
- The chemicals are separated by a '+' sign.
- The reaction is indicated by a '→' sign.

Ex.

$CH_4 + O_2 \rightarrow CO_2 + H_2O$

Ex. When Copper wire is put in a solution of Silver nitrate, we form a coat of Silver in a Copper (II) nitrate solution.

- $Cu + AgNO_3 \rightarrow Ag + Cu(NO_3)_2$

Law of Conservation of Mass

- "In a chemical reaction, the total mass of the reactants is always equal to the total mass of the products."
- Matter cannot be created or destroyed, it can only be moved around.

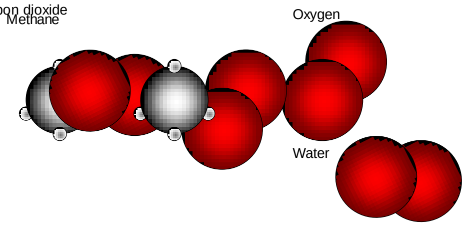
- If 7 g of Methane was react with 12 g of oxygen, 11 g of water would be produced and 8 g of carbon dioxide.
- Mass of reactants: 7 g + 12 g= 19 g
- Mass of products: 11 g + 8 g = 19 g
- Mass is conserved!

Balanced Chemical Equations

- An equation in which the reactants and products contain equal number of atoms of each type.
- A coefficient is added in front of a molecule or compound to indicate the number of molecules or compounds needed in the equation to follow the law of conservation of mass.

coefficients

$$CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$$



Balancing Chemical Equations

- There are several steps to help balance chemical equations.

1. Write the skeleton equation.
2. Make a list of elements and polyatomic ions in the reaction.
3. Count the numbers of each type of element or polyatomic ion the reaction.
4. Multiply each of the formulas by the appropriate coefficient to balance the number of atoms.

Coefficients are added to the front of the compound

$$Cu + 2AgNO_3 \rightarrow 2Ag + Cu(NO_3)_2$$

	Cu	$2AgNO_3$	$2Ag$	$Cu(NO_3)_2$
Cu	1			1
Ag		1/2	2(1/2)	
NO_3		2(1/2)		2

When one part of the chemical equation is changed every atom much be rechecked.

Multiply by 2 to get equal # of atoms

When all the atoms are equal, the chemical equation is balanced.

Iron reacts with oxygen to form magnetic iron oxide

$3Fe + 2O_2 \rightarrow Fe_3O_4$

	Reactants	Products
Fe	(1)3	3
O	2(2)	4

Combustion

- Combustion is a very rapid reaction between a substance and oxygen to produce <u>oxides</u>.
- The most common type of combustion reaction we will look at is the combustion of hydrocarbons.
- The combustion of a hydrocarbon always create carbon dioxide and water as products.

Hydrocarbon + Oxygen → Carbon dioxide + Water + Energy

We don't include energy in the reaction because it is not matter.

Ex.

$CH_4 + O_2 \rightarrow CO_2 + H_2O$ (Skeleton)

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ (Balanced)

Combustion of Butane

$C_4H_{10} + \frac{13}{2}O_2 \rightarrow 4CO_2 + 5H_2O$

	Reactants	Products
C	4	4(1)
H	10	5(2)
O	$\frac{13}{2}$ (2)	8 + 5 = 13

We cannot easily multiply 2 to equal 13. There are 2 ways to solve this:

1. Fraction
2. Multiplication

1. Fraction- Multiply the odd number over 2.

Combustion of Butane

$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$

	Reactants	Products
C	8	8
H	20	20
O	26	16 + 10 = 26

2. Multiplication- Multiply all the coefficients by 2 and the odd number goes in front of O_2.

Incomplete Combustion

- Incomplete combustion can occur when there is not enough oxygen for the reaction.
- Incomplete combustion will produce carbon monoxide and carbon along with the usual carbon dioxide and water.

Hydrocarbon + $O_2 \rightarrow CO_2 + H_2O + CO + C$

Synthesis Reactions

- Synthesis reactions involve the combination of smaller atoms and\or molecules into larger molecules.
- A + B → AB
- $2H_2 + O_2 \rightarrow H_20$

Decomposition Reactions

- Decomposition reactions involve the splitting of a large molecule into elements or smaller molecules.
- AB → A + B
- $NH_4NO_3 \rightarrow N_2O + 2H_20$

Single Displacement Reactions

- Single displacement reactions involve an element and a compound as reactants. One element displaces or replaces another element from a compound.
- Z + AB → ZB + A
- Metals replace metals and nonmetals replace nonmetals.
- $Br_2 + CaI_2 \rightarrow I_2 + CaBr_2$

Double Displacement Reactions

- Double displacement reactions occur when elements in different compounds displace each other or exchange places.
- AB + XY→ AY + XB
- Metals replace metals and nonmetals replace nonmetals.
- $Pb(NO_3)_2 + KI \rightarrow PbI_2 + KNO_3$

Energy in Chemical Changes

- Energy is involved in every chemical reaction.
- Energy is needed to break bonds and energy is needed to make bonds.
- The amount of energy gained and lost in a chemical change is never the same.

Endothermic reaction.

- Energy goes into (endo-) the reaction.
- More energy goes into the reaction than comes out of the reaction.
- Energy is considered part of the reactants.
- The products may feel cooler.

Reactants + energy → Products

Exothermic Reactions

- Energy exits (exo-) the reaction.
- More energy leaves the reaction than goes into the reaction.
- Energy is considered part of the products.
- The products may feel warmer.

Reactants → Products + energy

Kinetic Molecular Theory

- The theory behind how chemical changes occur says that molecules are moving all the time and need to collide into each other for a reaction to occur.
- How quickly or slowly a reaction occurs is called the reaction rate.
- Not all reaction occur at the same speed.
- Some occurs in split seconds.
- Some occur over thousands of years.

How fast a reaction occurs is affected by 2 things:

1. How many collisions between chemicals there are.
2. How effective the collisions between chemicals are.

Changing Reaction Rates

- There are 4 things that can be done to change the reaction rate of a chemical reaction.

1. Changing temperature
2. Changing concentration
3. Changing surface area
4. Adding a catalyst/ inhibitor

Changing Temperature

- Changing the temperature affects the reaction rate by:
  - Changing the number of collisions
  - Changing the effectiveness of the collisions
- An increase in temperature increases the speed of the particles
- A decrease in temperature decreases the speed of the particles.

- Higher temperature= faster reaction rate

(more collisions and more effective collisions)

- Lower temperature = slower reaction rate

(fewer collisions and fewer effective collisions)

Changing Concentration

- Changing the concentration affects the reaction rate by:
  - <u>Changing the number of collisions</u>
- Concentration is the amount of material
- High concentration has lots of material.
- Low concentration has small amount of material.

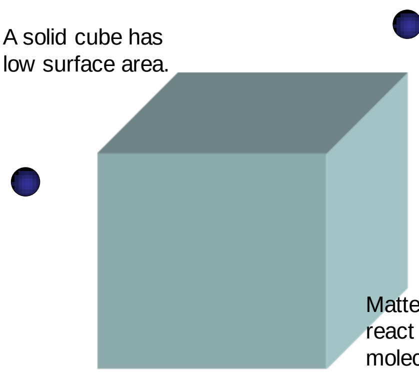
- Higher concentration= faster reaction rate (more collisions)

- Lower concentration= slower reaction rate (fewer collisions)

Changing Surface Area

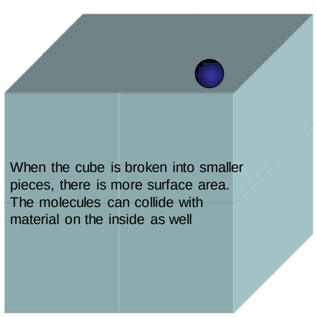
- Changing the surface area affects the reaction rate by:
  - <u>Changing the number of collisions</u>
- Surface area is the outside surface of a substance
- High surface area has lots of surface to collide with.
- Low surface area does not have a lot of surface to collide with.

A solid cube has low surface area.

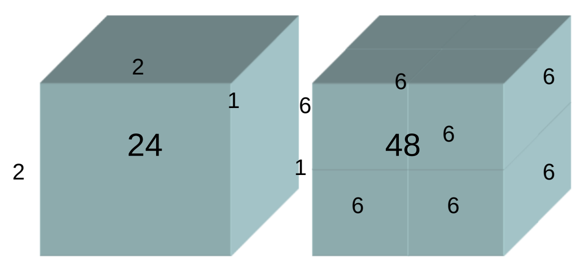


Matter can only react with molecules on the outside, not the inside

Now break the large cube apart



Calculating Surface Area



A= l x w

A= 2 x 2= 4

4 x 6 sides = 24

A= l x w

V= 1 x 1= 1

1 x 6 sides = 6

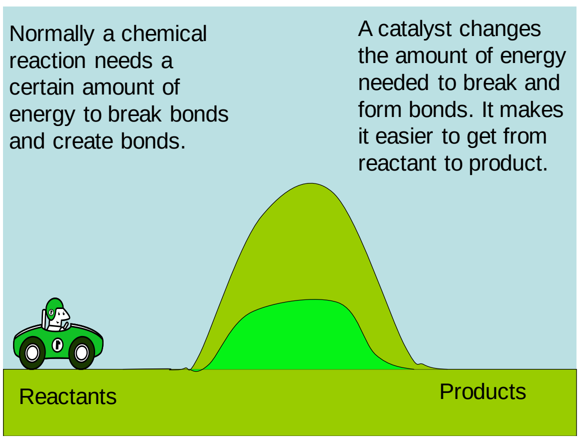
6 x 8 cubes = 48

- Smaller pieces creates more surface area.
- More area allows for more spaces for collisions
- A change in surface area changes the number of collisions.
  - More surface area= faster reaction rate
  - Less surface area= slower reaction rate

Catalysts/Enzymes/Inhibitors

- Adding a specific chemical to a reaction can change the reaction rate by changing the effectiveness of the collisions.

  Note- The chemical is not part of the reaction
  - The chemical is not a reactant or product
  - Catalyst- Chemical that increases the effectiveness of collisions= faster reaction rate
  - Enzyme-A natural protein that increases the effectiveness of collisions= faster reaction rate
  - Inhibitor- A chemical that decreases the effectiveness of collisions= slower reaction rate



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Science 10 Chemistry Unit Examples

Element	Atomic #	Mass #	Repres.	# of p	# of n	# of e
Al		27				10
	20					
				79		78
I					76	

Bohr Diagrams

Hydrogen

Helium

Lithium

Name:______________________________ P:___ Date:____________________________

Forming Stable Ions

Magnesium

Flourine

Periodic Table Trends

- Alkili metals: _____ charge
- Alkili Earth metals: ______ charge
- Boron's group: ____
- Nitrogen's group: ____
- Oxygen's group: ____
- Halogen's: _____
- Noble gases: _________________

*_____________ group doesn't usually form ________, but they can form either ______ or ______ ions.

Name:______________________________ P:___ Date:____________________________

Making molecules

Bonding

Lithium and oxygen

Writing Chemical Formulas for Ionic Compounds

Sodium Chloride

Magnesium bromide

Aluminum Nitride

Aluminum nitrate

Ammonium Sulfate

Transition Metals in Ionic Compounds

Ex. Copper (I) is ___________

Copper (II) is ___________

Name:______________________________ P:___ Date:____________________________

Copper (II) sulfate

Tin (IV) oxide

Naming Ionic Compounds

$NaCl$

K_2O

Mg_2N_3

$MgSO_4$

$Al(NO_3)_3$

Transition Metals:

$FeCl_3$

$FeCl_2$

FeO

$Sn_3(PO_4)_4$

Name:______________________________ P:___ Date:____________________________

Covalent Bonds

Carbon and Chlorine

Sulfur and Oxygen

Writing Names of Covalent Molecules

CCl_4

N_2O_5

PCl_3

Writing Formulas for Covalent Molecules

Silicon dioxide

Tricarbon hexaselenide

Name:______________________________ P:___ Date:____________________________

Recognizing the Type of Bonding

Name	Bonding	Formula	Formula	Bonding	Name
Sodium chloride			$CaBr_2$		
Carbon dioxide			CuO		
Magnesium oxide			HNO_3		
Tin (II) sulfate			N_2O_5		
Hydrofluoric acid			$(NH_4)_2CO_3$		
Phosphorous pentachloride			HBr		
Phosphoric acd			$SiCl_4$		

Balancing Chemical Equations

$$Cu + AgNO_3 \rightarrow Ag + Cu(NO_3)_2$$

Name:________________________________ P:___ Date:______________________________

$Fe + O_2 \rightarrow Fe_3O_4$

Combustion

Combustion of Butane